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ATN Over IP Models for Evaluation

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Agenda

- ATN and Global Aviation
- ATN over IP ?
- Candidate Architecture's – Transition Scenario
- Candidate Architecture – Interoperability Scenario
- Evaluation Summary
- Conclusion

ATN and Global Aviation

CNS

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- **Global Aviation community employs an industry specific set of standards - ATN**
- **Comprises application entities and communication services that allow ground, air-to-ground, and avionics data subnetworks to interoperate.**
- **ATN provides the following data communication services:**
  - **Air Traffic Services Communication (ATSC)**
  - **Aeronautical Operational Control (AOC)**
  - **Aeronautical Administrative Communication (AAC)**
  - **Aeronautical Passenger Communication (APC)**
- **ATN utilizes the TP4/CLNP stack as designed in ISO**

ATN over IP ?

- **Need for such a case**
  - **Operational benefits to aviation community**
  - **Manufacture of "All IP" aircraft by Airbus**
  - **Popular Internet applications can be leveraged**
  - **Widely used; Cost effective**
- **Is it Possible ?**
  - **Definitely ! (We have developed a CPDLC over TCP/IP Test-Bed for NASA Glenn Research Center)**
  - **IP is the basis for cabin, file server systems**
  - **Gatelink uses an FDDI link with non-OSI protocols**
  - **IP Satellite Service**
  - **Eurocontrol's IPAX experiment**
  - **ARINC 664 developing specifications for use of non-OSI protocols in aviation infrastructure**

Candidate Architecture's – Transition Scenario

- **3 different candidate architectures described**
- **Candidate Architecture 1**
  - **Transition Scenario Using Airborne Gateway**
- **Candidate Architecture 2**
  - **Transition Scenario Using Ground-based Gateway**
- **Candidate Architecture 3**
  - **Transition Scenario Using IP Subnetwork Dependent Convergence Function (IP SNDCF)**

Transition Scenario Using Airborne Gateway

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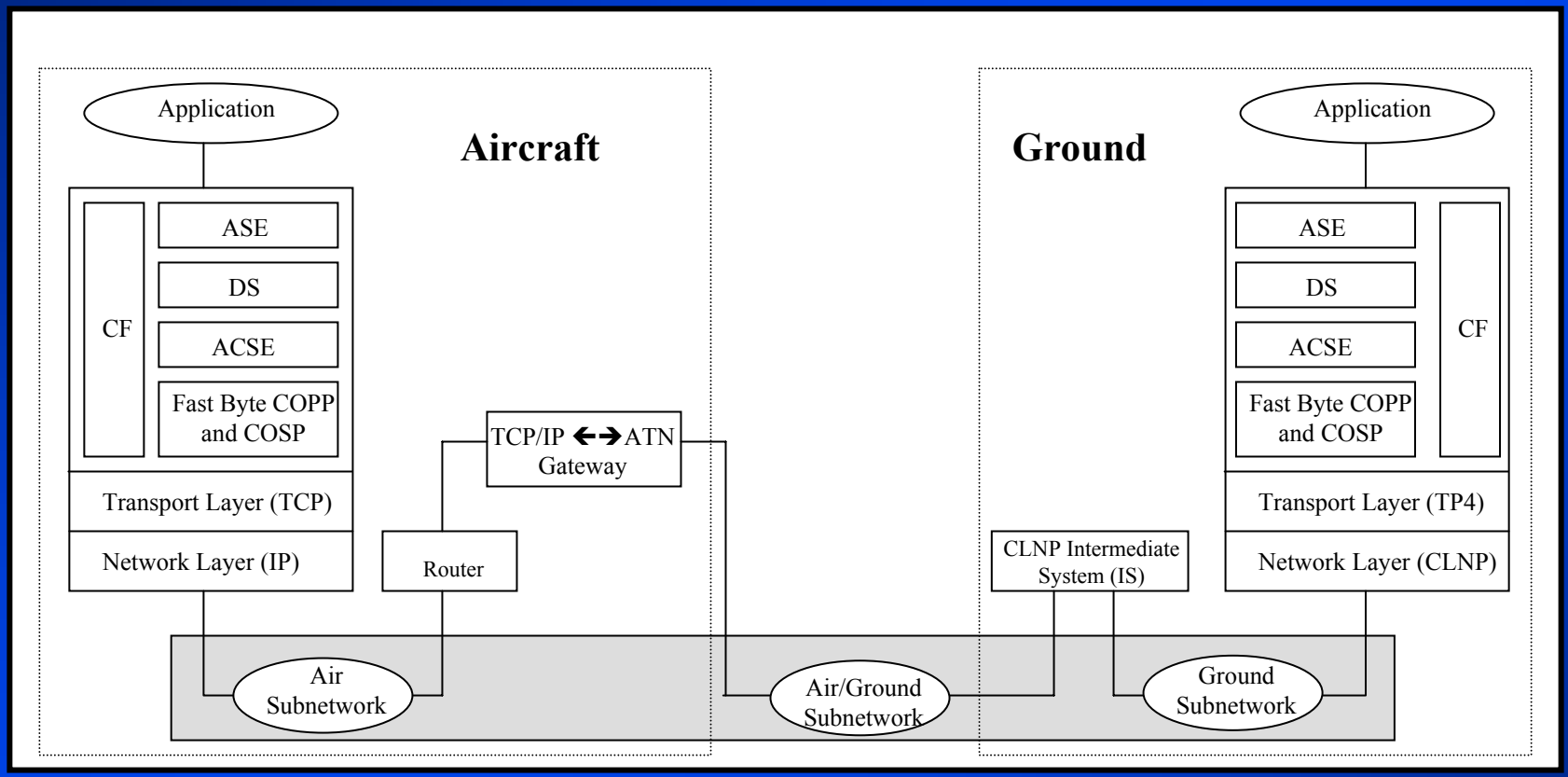

Assumptions

- *Aircraft network is IP based*
- *Ground systems are still ATN based*
- *Gateway function resides onboard the aircraft*

Transition Scenario Using Airborne Gateway (cont..)

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Highlights

- Gateway function may be implemented at
  - the Application Layer (or)
  - the Transport Layer
- Preferred to implement Gateway at the Transport Layer
- ATN ←→ IP Address translation takes place only on the aircraft side
- No address translation required on the ground side

Data Link Critical Aspects

- Mobility
  - Since the Gateway resides within the aircraft's onboard network, the TCP/IP stack will be independent of mobility aspects. The outer side of the Gateway, which uses TP4/CLNP will provide for mobility support in accordance with ATN SARPs.
- Security
  - Provided as per ATN SARPs
- QoS
  - Provided as per ATN SARPs

Airborne Gateway at Transport Layer

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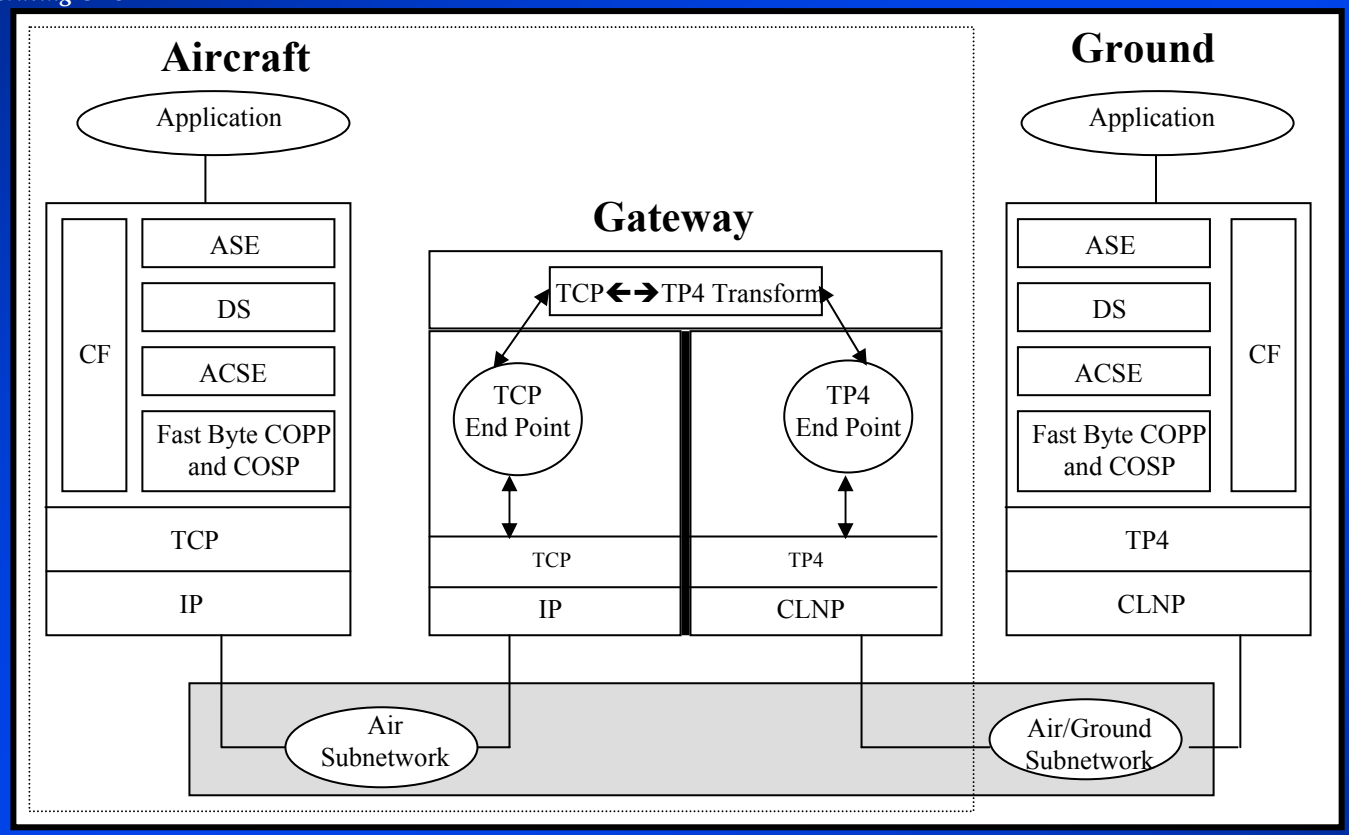
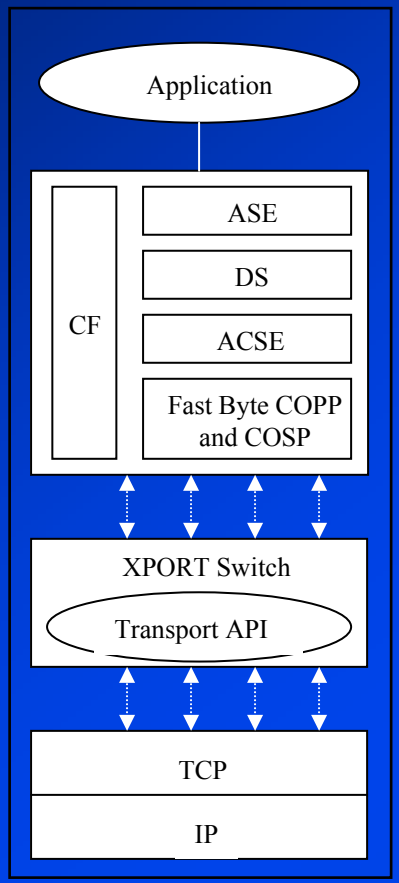


Gateway Functions

- *Terminating TP4/CLNP on one side and translating that connection into TCP/IP on the other side and vice-versa*
- *Managing both TCP and TP4 termination points*
- *Address translation between the IP domain and the ATN domain*

XPORT Switch



- *A logical entity to provide "glue" logic or an interface for ATN upper layers to use TCP/IP services*
- *XPORT Switch should perform the following tasks:*
  - *Interface to upper layers*
  - *Address translation*
  - *Well-known port mapping*
  - *Interface to TCP/IP*
- *Mechanism to achieve ATN to IP address inter-working depends on whether the upper layers are aware of IP addresses or work strictly with ATN NSAPs. Two possible cases are:*
  - *IP addresses embedded in NSAP*
  - *ATN applications speak true NSAP*
- *Detailed information on the above 2 cases is available from:*
  - *IETF RFC 1888 "OSI NSAPs and IPv6"*
  - *IETF RFC 2373 "IPv6 Addressing Architecture"*

Transition Scenario Using Ground-based Gateway

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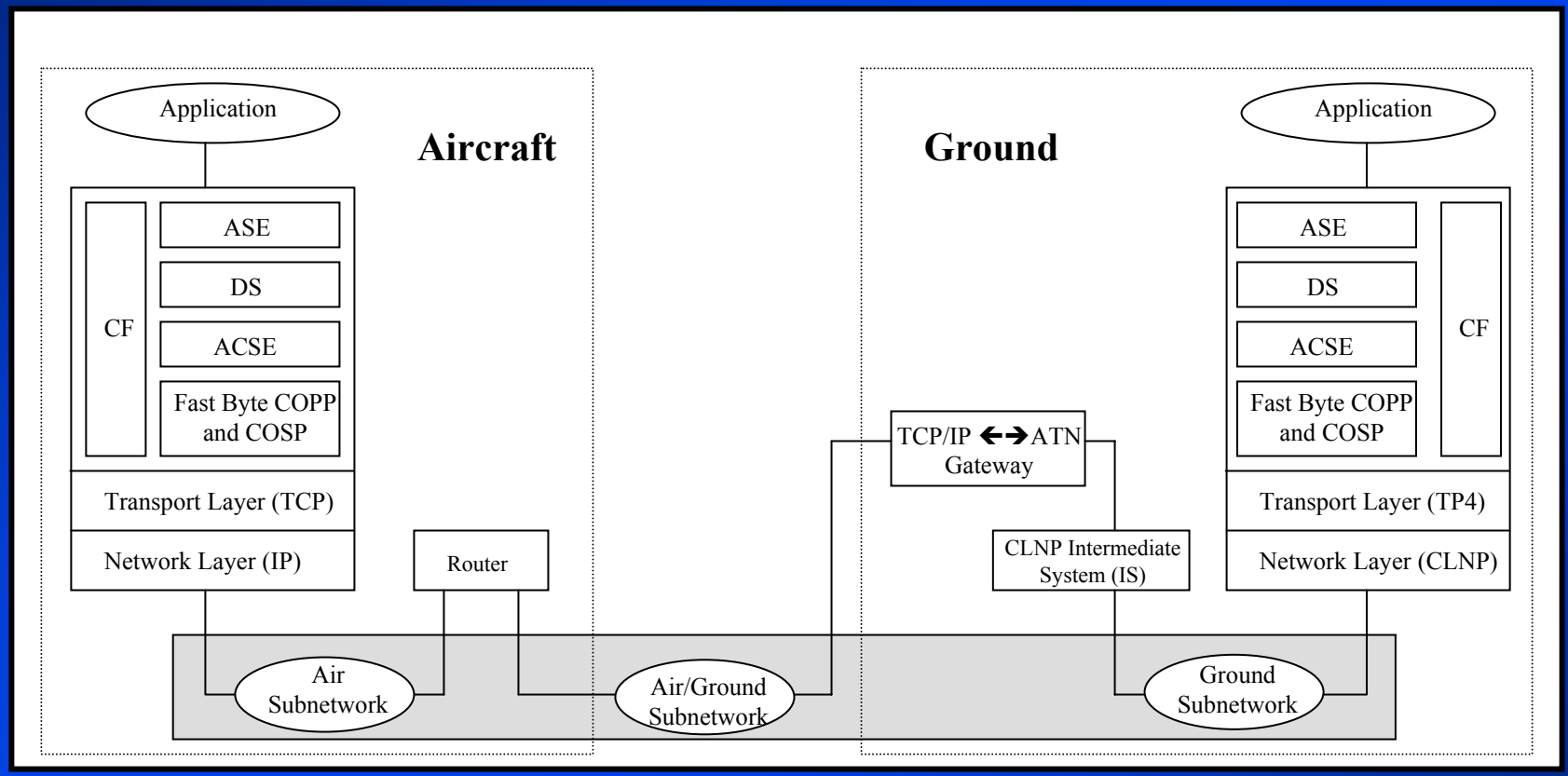

Assumptions

- *Aircraft network is IP based*
- *Ground based applications are TP4/CLNP based*
- *Gateway function resides as part of ground network*

Transition Scenario Using Ground-based Gateway (cont..)

Highlights

- *Preferred to implement Gateway at the Transport Layer*
- *Gateway functionality similar to that illustrated in previous case*
- *ATN←→IP Address translation takes place on the aircraft side, as well as the ground side*

Data Link Critical Aspects

- *Mobility*
  - *Since the Gateway resides as part of the ground network, support for mobility is provided by Mobile IP*
- *Security*
  - *Provided by IPSec*
- *QoS*
  - *Provided by employing Flows, DiffServ, RSVP*

Transition Scenario Using IP SNDCF

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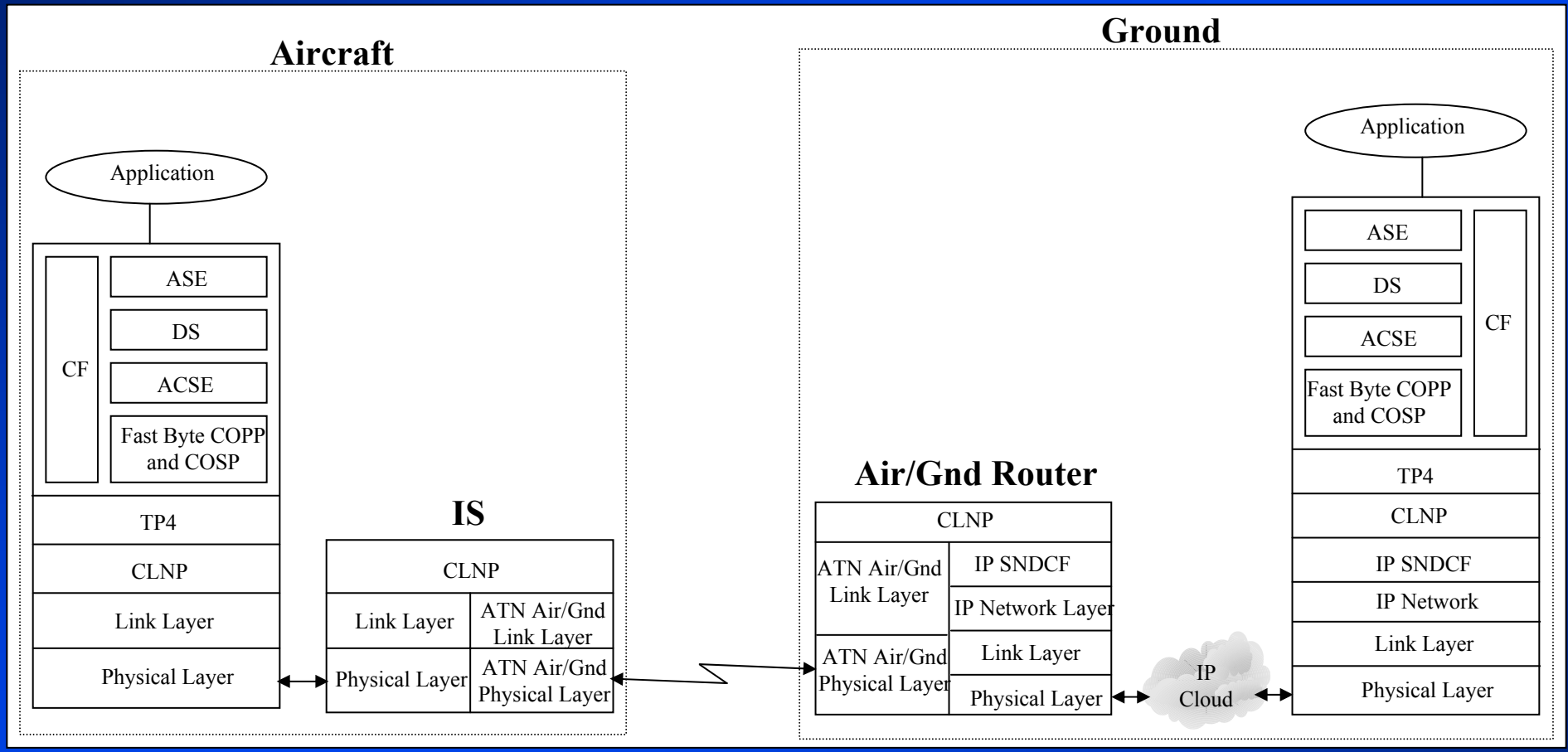

Assumptions

- *Aircraft network is ATN based*
- *Gradual replacement of CLNP with IP on ground side*
- *IP SNDCF provides CLNP to IP protocol conversion*

Transition Scenario Using IP SNDCF (cont..)

Highlights

- ATN applications would continue to operate as currently defined
- No address translation issues, as ATN applications continue to "see" the familiar TP4/CLNP stack
- Ground network is IP based
- ATN←→IP Address translation takes place only on the ground side

Data Link Critical Aspects

- Mobility
  - Provided in accordance with ATN SARPs.
- Security
  - Provided as per ATN SARPs
- QoS
  - Provided as per ATN SARPs

Candidate Architecture – Interoperability Scenario

- **1 Candidate Architecture described**
  - **Interoperability Scenario Using TCP/IPv6**

Interoperability Scenario Using TCP/IPv6

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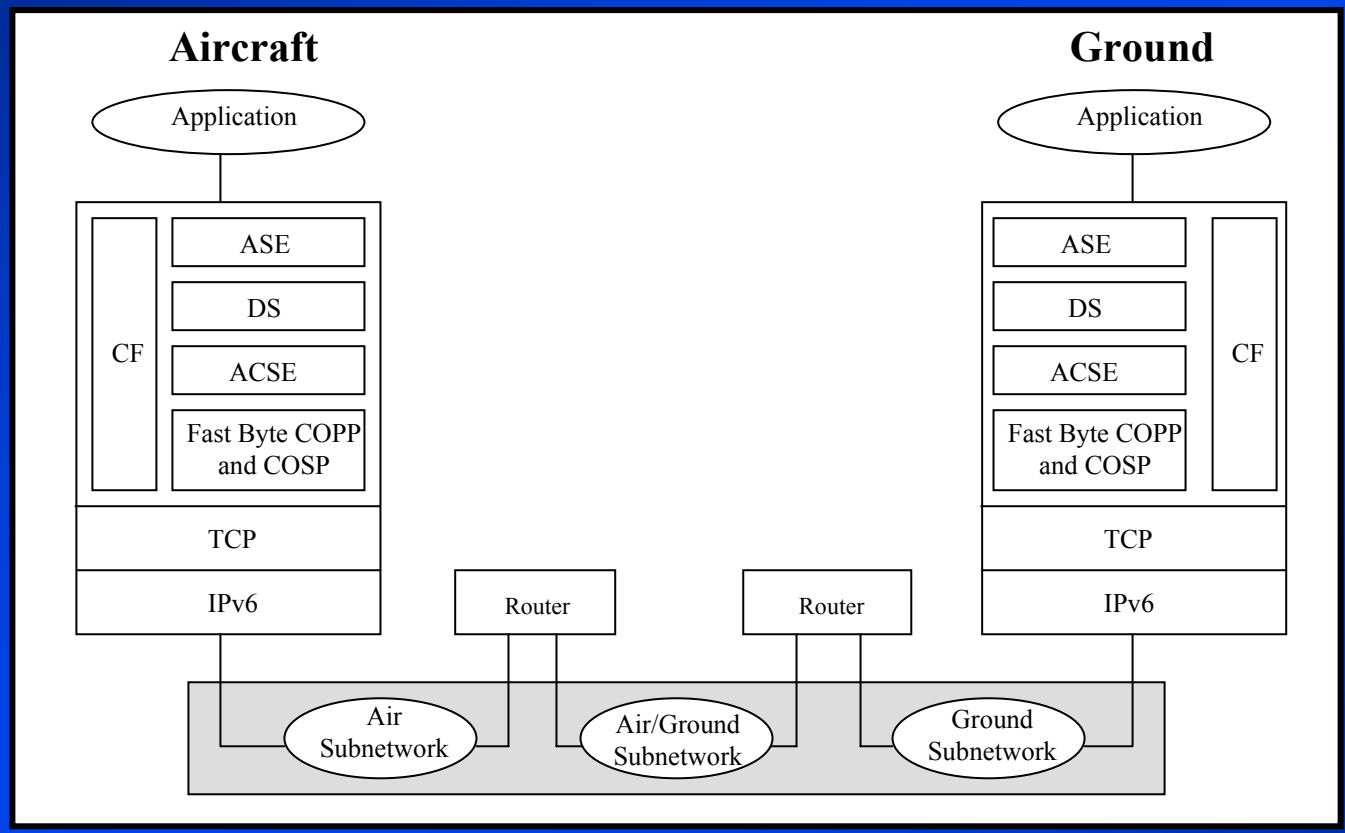

Assumptions

- *Major shift in technology from CLNP to IPv6*
- *Aircraft network is IPv6 based*
- *Ground network is IPv6 based*

Interoperability Scenario Using TCP/IPv6 (cont..)

Highlights

- Three possible addressing options:
  - ATN applications use NSAPs as defined under ATN SARPs, but address translation is carried out at XPORT layer
  - ATN applications use IPv6 addresses embedded in NSAP structure
  - ATN applications use IPv6 addresses instead of NSAPs

Data Link Critical Aspects

- Mobility
  - Provided by Mobile IPv6
- Security
  - Provided by IPSec
- QoS
  - Provided by employing Flows, DiffServ, RSVP

Evaluation Summary

Transition Scenario Using Airborne Gateway	■ Presents a transition scenario ■ Mobility as in ATN SARPs ■ Requires retrofits to avionics on every aircraft
Transition Scenario Using Ground-based Gateway	■ Presents a transition scenario ■ Mobility support by Mobile IP ■ No retrofits to avionics required
Transition Scenario Using IP SNDCF	■ Presents a transition scenario ■ Mobility as in ATN SARPs ■ ATN applications continue to operate as currently defined ■ Impact on current ATN model appears to be minimal
Interoperability Scenario Using TCP/IPv6	■ Major shift in technology ■ Mobility support by Mobile IPv6 ■ All systems are IPv6 based ■ IPv6 provides a large address space ■ IPv6 provides enhanced Security and QoS features

Conclusion

- Intent of this paper is to explore the design and development of candidate architectures to enable ATN applications to leverage the potential benefits of using the TCP/IP stack
- Paper presents three "Transition Scenario" candidate architectures, and one "Interoperability Scenario" candidate architecture
- Feasible models could be identified for further study and provide a guidance for transitioning of existing and future "non IP" based applications to the IP environment

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